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THE COMPOSITION
OF
DUTCH BUTTER

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OF
DUTCH BUTTER.

With the Publisher's Compliments

BY

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ON THE COMPOSITION
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It has repeatedly happened that Dutch butter, the origin of which placed its genuineness and purity beyond doubt, has been wrongly declared by foreign chemists to be a mixture of butter and margarine. This deplorable error, which is largely accounted for by the varying composition and appearance of this butter at different times of the year, is greatly to the prejudice of Dutch butter producers, who suffer great loss in consequence, especially as regards their English trade. For that reason the Netherlands Government resolved to cause a full examination to be made into the composition of Dutch butter produced in the latter months of the year, because it was noticed that the difficulties arose almost exclusively in the course of each autumn.

It was likewise known that also at other times there was occasionally butter differing in chemical composition; and the Government desired to ascertain the causes of these abnormalities, and to know in what proportion their quantity stood to the normal qualities. Hence Prof. H. P. Wysman, of Leyden, was entrusted with the conduct of the enquiry, and the chemical investigation was delegated to myself. The chief aim was to show English chemists the real position of affairs, and to that end it was deemed desirable to ensure identity of the methods employed in the laboratories of both countries. Through the kindness of Prof. Thorpe both Dr. van der Zande and Prof. Wysman were enabled to acquaint themselves with the analytical methods employed in the Government Laboratory, and the methods followed by me are identically the same as those used in England.

This renders a description of them here superfluous, and I can at once proceed with the result of the full examination as made by me.

Enquiries as to the variation in the composition of butter date from recent times, and find their origin in the search for a method to distinguish butter from other fats. After margarine had entered the field there came an opening for dishonest traders to adulterate on a large scale; and the great similarity in appearance, taste and smell between such like substitutes and genuine butter soon rendered the aid of science indispensable in distinguishing the true products from the false.

Butter is distinguished from other animal fats by a high percentage of volatiles and a comparatively low percentage of insoluble non-volatile fatty acids.

Hehner and Angell were the first to utilise these characteristics in working out a method enabling us to chemically distinguish butter from its substitutes. The formula giving the percentage of insoluble fatty acids is more specially known as the "Hehner formula." Hehner at first thought himself justified in regarding all butters containing a higher percentage than 88 as adulterated.

In 1879 Reichert changed the method by testing the volatile fatty acids, his method being subsequently altered and worked out by Meissl and Wollny, and still later by Leffmann and Beam.

Reichert found in all butters analysed by him a figure varying from 26.8 to 29, and believed all butters with a lower figure than 26.5 to be adulterated.

Soon, however, it became apparent that undoubtedly pure butters exist having a much smaller percentage of volatile fatty acids, and consequently a much higher one of solid acids than was at first presumed. Gradually the accepted limit had to be abandoned, and at the present moment one is not justified in stigmatising as adulterated a butter with a Reichert-Wollny figure of 19 and a Hehner number of 91. I shall make it clear that figures for the Hehner number under 91 and for the Reichert-Wollny over 19 can relate as well to pure butter as to butter adulterated with foreign fats.

What I said about the Reichert-Wollny figure and the Hehner figure is also applicable to the numbers obtained by other methods for other ingredients of the butter-fat, as here, also, great differences are observed.

Whilst people were at first satisfied with the determination of the extreme limits, attention was gradually drawn towards the more scientific side of the question, and people began to enquire whether any regularity could be observed in the fluctuations in quality to which butter is subject, and if so, whether their causes could be traced. Numerous scientific analysts have occupied themselves with this problem, and it is pretty well taken for granted that these fluctuations are governed by certain rules. But when testing and comparing the conclusions arrived at with regard to the causes of these fluctuations, it is soon rendered evident that there does not exist the slightest harmony between them. One can, however, plainly distinguish that there are two groups of analysts, one of whom accepts as chief factor the lactation period of the cows, while the other attributes the greater influence to the fodder. I have, however, to point out that no hard and fast line can be drawn between these groups, since opinions and conclusions vary.

The influence exercised by the lactation period of the cow on the daily milk production, is so generally known and so regularly observed by every cattle farmer, that it seems perfectly superfluous to bring forth more proofs, and there is just as little to justify a discussion on the modifications in the percentage of fat contained in the milk, which modifications can be noted as the lactation period progresses. But on the other hand it is desirable to draw attention to the observations made with regard to the influence of the lactation period on the composition of butter.

Prof. L. Mayer (Agricultural Report for 1888) arrives at the conclusion and demonstrates that the proportion of volatile fatty acids in butter and the specific weight connected therewith are dependent upon the lactation period in such a way that it grows less as the lactation period advances.

Nilson (1887) concludes from his experiments, in which, moreover, the influence of fodder was studied, that in the course of the lactation period the alloy of volatile acids in butter diminishes. The colostrum-fat showed a very low proportion of volatile acids.

Dr. Schrodt and O. Henzold (Agricultural Report for 1890, p. 349) published in 1889 the result obtained by them in the enquiry as to the causes of the variable composition of butter.

For that purpose ten cows were isolated, of which the butterfat was analysed from eight to nine times monthly, while, moreover, the fat of the milk of one cow was tested separately as to its composition. The conclusion at which the above-named analysts arrived was that the ratio of volatile acids is dependent on the lactation period, but not on any other factors.

But when we come to examine the figures seriously as basis for the monthly averages, we perceive that we cannot in this instance have to reckon solely with the lactation period, but that yet another factor makes its influence strongly felt.

For different samples were found on :—

SEPTEMBER.		OCTOBER.									NOVEMBER.
28	28	2	5	9	12	16	19	23	26	30	2
24.7	26.1	23.6	24.1	25.7	25.6	26.1	26.4	27.9	27.5	27.7	27.6

It is seen from this that the increase is plainly apparent before one of the cows has a calf. The first cow had a calf on October 17; the milk of this animal will consequently not have been used for butter-making purposes before October 23, notwithstanding which, we find the lowest figure on October 2 increasing constantly to 26.4 on October 19. The writers just cited have, however, overlooked this; and they also failed to note that they had to reckon with yet another factor, namely the stabling of the cows. It is seen from their elucidation that the cows returned to stable on October 3, and I, even at this point, want to emphasise this circumstance, to which I shall have to revert later on.

In conclusion I wish to draw attention to the experiments of Dr. Swaving (Agricultural Report for 1891, p. 127), who was the first to collect the particulars necessary to become familiar with the composition of Dutch butter at different times of the year. He drew attention to the appearance of butter with a very low figure of volatile acids, and came to the conclusion that the lactation period exercises the first and foremost influence upon the composition of butter. In his latest publication (an article which appeared in the "Zeitschrift für Untersuchung der Nahrungs-und Genussmittel," 901, No. 13), he arrives at the conclusion that the fall of the proportion of volatile fatty acids in the autumn is due to the bad condition of the grass in the meadows.

To the question whether in the light of physiological science we may reasonably expect to find that the fodder affects the composition of the milk, an affirmative answer can be given in so far that an insufficient quantity of food fails to restore the decayed lacteal gland cellules, causes an abnormal state of the body, and could possibly in an indirect way affect the functions of the lacteal glands; for, according to our present knowledge, the specific component parts of milk are not conducted with the blood to the udder, but are formed within the latter.

About a century and a half ago Beccaria held an opposite doctrine; it was then generally believed that the fat present in food was as such found again in unaltered form in the animal fat and in the milk. Towards the middle of the nineteenth century Liebig successfully opposed this doctrine, and from that time Beccaria's theory was considered obsolete. Nevertheless, the idea of direct connection between the composition of the food and those of the products of bodily changes is not wholly rooted out; and theories continually crop up which bear testimony to different conceptions.

In various experiments, also, in recent years, results have repeatedly been obtained which seemed to point to a direct connection between the food composition and milk composition, even if they do not seem to give rise to the supposition of a direct translation from the components of food into those of butter-fat. I, therefore, do not agree with Sebelien when he compares the folly of thinking that it is possible to modify the percentage of the fat contents of milk by diet, with that of attempting to develop the memory by using one special kind of food, the logical faculties by another, and musical talent by a third. In order not to arrive at incorrect conclusions, when studying the influence of food, we have to keep two matters totally separated from each other, namely:—

1. The influence of food as regards the assimilation of its parts as such in the milk.

2. The influence of food as a factor of the whole material interchange of the animal, consequently on the whole state of the

body and then indirectly on the composition of the products secreted by the body. I wish to emphasise this distinction as much as possible and to keep it constantly and clearly in view during the whole course of this discussion. It is my firm conviction that it is precisely by the confusion of these two factors that we can account for the perplexity and divergency of view which now characterise the works and writings dealing with the influence of food on the composition of milk and its products.

One might suppose that, by virtue of its origin, milk cannot possibly be the mere result of transposition of the elements composing food; but we must be cautious with our deductions and see whether practical results agree with the theory. Even practice can err, as well as theory, and be led astray by secondary influences, as is clearly shown by the lack of agreement among experts.

When considering the results obtained by the experiments conducted in the course of the last decades with a view to ascertaining the influence of nutrition on the quantity and quality of the milk, it is quite plain that this question has not yet been definitely solved, and that the conclusions are widely divergent.

Klein and Heinrich concluded that nutrition does exercise influence on the quantity and quality of the secreted milk, and that the specific parts of the food as such are transposed to the milk.

Van Dreser, Cornevin, Pankoroski, Fedderson, Zirn, Mink, Sebelien, Heinrich, Turner, Mayer, Wiley and Soxhlet took it for granted that nutrition exercises an influence on the quantity and quality of milk fat, without the parts of the food themselves changing into milk, but so that a certain food also causes certain changes in the lacteal composition, or, as suggested by Soxhlet, that the fat contained in food, provided it be in digestible form, forces the fat tissues of the body into the milk without going there directly itself.

Kühn (1875 and 1876), Lehman, and Swaving believe from the results of their experiments that the influence of the feeding acts in such a way on the quantity and quality of the milk that both are altered in proportion to the food being more or less nutritious, independent of the nature of the nutriment, provided it can be digested by animal organism in the normal way.

Wolff, Kühn (in 1869), Flescher, Wood, Spier, Wing, Leufven, Fjord, Früs, Twietschke, Nilson, Schrodt and Henzold take the view that the feeding exercises no influence whatever. Where the opinions of so many clever men are so widely divergent, it is undoubtedly difficult to pronounce oneself in favour of one of them.

To me, however, Lehman's point of view seems the most correct. He believes that the composition of milk is only in so far dependent on the food, that a more or less substantial food will make its influence felt, independent of its nature and composition; always supposing that the food be digestible, and that certain obvious limits be not exceeded.

The opinions of those who deny all influence to food, do not in general clash with this view, because they compare with each other foodstuffs which, as regards their greater or lesser value as nutriment, do not differ greatly.

What precedes shows that from most of the influences which have been discussed here, we must revert to the general functions of the body. Neither the lactation period nor the food act directly upon the lacteal gland; they act by interference with the general functions of the body, when in indirect manner the lacteal glands modify their function. It need not, therefore, surprise us, that other circumstances, independent of nutrition and lactation period, can exercise an influence upon the quality of the milk and its products. This has been indirectly proved by experiments, taken with the same feeding materials and under the same conditions of the lactation period, giving such widely different results. There must be other factors at work, and amongst these we must include those affecting health and the psychological life of the animals. In all experiments with animals it must be remembered that the action of the nervous system is an important factor, and it may be taken for granted that the psychical life affects milk secretion. It follows from this that I quite agree with Sebelien where he entertains doubts as to whether the influence of pasturage in springtime, acting favourably on the secretion and composition of milk, should, as is the custom, be attributed to the direct action of grass nutrition, or whether it must be regarded as a consequence of other contemporaneous influences. "It is pretty well beyond doubt," he says, "that the milk secretion is to a high degree influenced by the functions of the nervous system, and that the psychological effects play a considerable part not only with man, but also with highly organised domestic animals." We regard a sojourn in pure air specially during the summer, as a general remedy for mental as well as for physical ailments. The pedestrian gathers new strength in the mountain air, even while taking less nourishing and wholesome food than he takes at home. This is rightly attributed to the nerve strengthening action of change of air, and, in general, to psychical diversion. Is it improbable then, that the higher proportion of fat in the milk of grazing cows, may at least in part be attributed to the more pleasant surroundings, and the effects upon the minds of animals who have been confined for so long in the stables?

As this subject has received but scant attention, I am unable to cite the conclusions of other investigators. But analytical results obtained by others seem to point to conclusions which, so far, have been overlooked, and in any case medical works contain evidence that in human beings at least the nervous system reacts on milk secretion. Thus, Steyner, in his "Physiology" (p. 200), says: "The influence of the nervous system is apparent in any case; the milk secretion may be modified by physical influences: by artificially irritating different nerves a change in the milk secretion has always been observed." We find another verdict in this direction by Lauder-Brünton.* The composition of milk, we read, is subject, in a high degree, to the nutrition and exercise of the mother. It often occurs that the milk of a wet nurse, which during the first time perfectly satisfies the infant, soon loses its good quality. Before making her entry as a nurse she had plenty of exercise in the fresh air and wholesome food, while now she is being fed excessively and seldom leaves the house. In order to regain the former healthy quality of her milk, the nurse's mode of life has to be altered both as regards food and exercise. As far as hitherto known, no experiments have been made as to the influence of temperature on the lacteal glands; we can only quote in this respect an instance dealing with perspiration. When, for instance, the nervous ischiaticus, a principal nerve in the anterior extremities of an animal, is irritated, perspiration appears on the foot, the nerve of which was operated on; this perspiration, however, is much less when the foot is cold than when it is warm.

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* "Pharmacologie und Therapie," p. 510.

Concerning different experiments made to trace the influence of nutrition and lactation on milk secretion, repeated observations have been passed which clearly indicate the action of agencies affecting the body in general.

The experiments of Nilson are very remarkable, showing a higher percentage of volatile fatty acids in butter, made from the morning milk, than in butter made from the evening milk, during the months November-March. This difference gradually disappears in April, and is so diminutive in summer time as to be hardly perceptible; increasing again in the months of September and October. Nilson connects this fact with the circumstance that the Swedish autumn and winter nights, compared with the spring and summer nights, are exceptionally dark, while one can hardly talk of proper nights during spring and summer time. And wherever a draught was observed Nilson always found a decrease of percentage of volatile acids in butter. But Kühn and Fleischer could not observe any influence of this cause on the percentage of fatty contents. Pankowski says, in his already mentioned treatise: "Illness, excitement, disturbance and other outside factors, have a very great influence on the size and quantity of fat corpuscles." A. Mayer offers, in connection with the decrease of milk production during the last weeks of stabling time, the following remark: "The animal being used to run in the meadow during the summer, gets uneasy in the stable at the rising temperature of spring; it smells, as the stable boy has it, the young grass, it gets just like we higher beings, the spring-feelings, only with this difference, that those in connection with his brutish psychical life have more regard to material matters than with us. It becomes uneasy, hardly eats anything, digests badly, and the milk secretion decreases." Ducunson concludes:* that although the cows were in the meadows only during the first half of the period preceding the experiments, and were put in the stable later on, yet the influence of the weather was to be traced to some extent. Notably, sudden storms and falling temperature caused decrease of milk production and of the proportion of fat. Henkel, in his treatise on the influence of tiring exercise on milk secretion, concludes that such exercise decreases both milk production and "absolute" quantity of the produced dry ingredients of milk. This decrease is more or less noticeable at the first milking, but it becomes more important at the second. The quality of the milk changes as regards all its component parts. The water percentage falls at the first milking, still more so during the second, but then rises slowly till it becomes constant. The percentage of albumen grows in the first milking time, which increase continues slightly in the second, and then falls to the normal point. The fat has considerably augmented after the exercise at the first milking time, and still more so at the second, and then falls to the normal point. The percentage of milk sugar shows a fall at the first milking (sometimes continuing during the second) and rises at the second milking, becoming normal at the following one. The cineritous percentage is at the first milking decidedly higher, afterwards falling off to normal. The acidity somewhat falls off.

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* 7 Jahres Ber. der Agr. Exper. St. of Nebraska Ref. Milchz, 1895, 14 Sept.

The experiments by Dr. A. Morgen, the results of which were published in Bd. LI. of "Die Landwirthschaftliche Versuchsstationen," page 117, are important. The conclusion to be arrived at is that from an economic point of view it would be profitable to utilise the cows as beasts of labour, provided the performed labour be moderate. It may be stated that, with a moderate performance of labour, the production of lacteal component parts did not seriously diminish. Against a small decrease in milk production a greater proportion of fat was observed; indeed, the total fat production per day was somewhat higher. It should be observed here that the experiments were made with two cows only, but were for the rest carefully executed.

At the end of the report on the treatise of Früs and others, Sebelien says (H. op., page 323 of Biederman's "Centrallblatt f. Agriculturchemie," 1897):—"It would have been better not to consider the observed change in the composition of butter-fat consequent on modified nutrition as a proof of the conversion of alimentary fat into butter-fat. The composition of butter-fat as well as the percentage composition of milk is, even by unchanged nutrition from day to day and from period to period, subject to important changes. We regard these as a consequence of the changing disposition of animals, and we are, at least in the above-mentioned cases, not inclined to accede to the working of the feeding materials any direct influence on the milk-composing parts, but to the disposition and the nervous action of the organism governing milk secretion."

It does not seem necessary to say more upon this subject. It has been clearly proven that when tracing the influences governing the composition of milk and butter, we have to take account of circumstances, which possibly may influence the individual. Just these circumstances, amongst which I place those governing the psychological life of the cow, have up till now been too much neglected.

II.

In order to become acquainted with the composition of Dutch butter during the latter months of the year, butter from various dairies in different parts of Holland were weekly analysed as much as possible.

To exclude all doubt as to the purity of the analysed butter, a special official was appointed to choose the samples from butter churned in his own presence.

The places were selected so that they should differ as much as possible, as well regarding the usual stable fodder as the soil during grazing time. Moreover, butter has been taken just as well from factories as from farms, because manufactured butter indicates the average composition to a greater extent; farm butter, on the contrary, offers a greater opportunity for collecting other data important to this study. Notes were carefully drawn up of all circumstances that could be expected to influence composition. Particulars were collected under the following heads:—

1. Number and breed of the cows from which the butter was obtained.
2. Age of the cows.
3. Date on which the cows last had a calf.
4. Approximate date of the next throwing of calf.
5. Nature of soil on which they grazed.
6. Nutrition.
7. Date of their being stabled.

For 25 tables, arranged in order of time, I have collected the figures obtained by the examination of the butter made at the different places. These figures relate to refraction, specific weight, volatile acids, solid acids, dissoluble acids, saponification value and iodine value.

In order to judge the average composition of butter at different periods, I have given, on a separate table, the numbers giving the average of the numbers denoting the percentage of volatile fatty acids of all samples analysed during that week.

September				October			
7-12	14-19	21-26	28-30	5-10	12-17	19-24	26-31
25.9	24.8	24.6	23.3	23.7	23.5	23.6	24.0

November				30 Nov. to 5 Dec.	December		
2-7	9-14	16-21	23-28		7-12	14-19	21-26
24.0	25.7	25.6	25.7	26.0	26.8	26.5	27.0

The averages derived here for each month are

September	24.8
October	23.7
November	25.2
December	26.6

We see from this that the percentage of volatile fatty acids is lowest in October, and rises in November to a higher point than it reached in September, and rises still more in December. This shows that one has to be very cautious in judging whether butter made during the months of September and October be adulterated or not by an admixture of foreign fats, and that in very many cases one has to put a very low limit of the percentage of volatile fatty acids is shown by the following returns, which indicate how often

" saturation " figures are found amongst the 428 samples analysed during this time, that lie between the given limits :—

Figure of Saturation of Volatile Fatty Acids.	Number of Samples.
From 17–18.9	3
,, 19–19.9	3
,, 20–20.9	8
,, 21–21.9	28
,, 22–22.9	34
,, 23–23.9	64
,, 24–24.9	74
,, 25–25.9	56
,, 26–26.9	67
,, 27–27.9	43
,, 28–28.9	34
,, 29–29.9	9
,, 30–33.0	5
Total	428

As the lowest limit for the saturation point of volatile fatty acids, 25 is generally accepted, I believe, also in England; yet how often, with this number as a standard, could pure butter be stigmatised as adulterated, is clearly shown when we consider how many butters showed an average of volatile fatty acids below 25. According to the above-mentioned list, exactly fifty per cent. of all Dutch butters analysed by me show a saturation point of volatile fatty acids below 25.

By means of another classification of the numbers we are able to demonstrate even more clearly the periodic changes in the composition of butter during the last four months of the year. When we calculate for each month separately how often a certain saturation figure of the volatile fatty acids is found among the analysed butters in that month, we find the following percentage:—

Saturation figure.	SEPTEMBER. Per cent.	OCTOBER. Per cent.	NOVEMBER. Per cent.	DECEMBER. Per cent.
18–20.9	1.9	6.0	4.5	0.0
21–22.9	16.8	20.0	13.9	4.3
23–24.9	33.4	52.6	26.4	11.8
25–26.9	35.3	14.7	27.5	40.6
27–28.9	11.7	6.2	23.2	34.3
29–30.0	0.9	0.0	4.5	9.0

We conclude herefrom that the number of butters with a saturation figure of volatile fatty acids smaller than 25 increases from September to October from 52.1 to 79.1 per cent., while, on the contrary, the number of saturation figures above 25 decreases from 47.9 to 20.9 per cent. We see the reverse after October, for from October until November and December the number of butters with a saturation figure of volatile fatty acids lower than 25 decreases, while the number of butters with a saturation figure over 25 increases. The number 25 seems, consequently, as regards the saturation figure of volatile fatty acids, the turning point of the percentage, so that an increase is noticed in the number with a higher saturation figure, as well from October backwards to September, as from October to November and December. On the other hand the number of samples with a saturation figure of volatile fatty acids below 25 decreases, as well from October to September, as from October to November and December. The month of October is the turning point when the changes begin.

As regards the other chemical characteristics of the analysed butters, we can only expect, as regards the indissoluble and soluble fatty acids, that these are likewise subject to important variations. It is known that the proportion of dissoluble fatty acids to volatile fatty acids is fairly constant, the percentage of volatile fatty acids amounting to about 85 to 92 per cent. of the dissoluble fatty acids. The percentage of dissoluble fatty acids is, according to English custom, in England expressed as the percentage of butter-acid. The percentage of dissoluble fatty acids must rise and fall together with the percentage of volatile fatty acids, and such is indeed shown to be the case by the tables. The indissoluble fatty acids form the supplement to the dissoluble and volatile fatty acids. Their total forms the total percentage of fatty acids; consequently if the one is lowered the other must rise, and *vice versâ.* We notice that in the tables the percentage of indissoluble fatty acids rises where the saturation point of volatile fatty acid falls, and the reverse. It is superfluous to repeat the arguments advanced when treating of the volatile fatty acids.

In regard of the saponification figure, we may observe that this moves in the same direction as the percentage of volatile fatty acids, which is not astonishing when we consider by what this is determined.

When tracing the course of the iodine value in this period it appears to be very difficult to find any regularity. In the beginning the movements are not large and very little characteristic, for we can denote a rise here, a fall somewhere else, without being able to properly account for it. We only see that for the different places of origin similar movements are recorded, and notice that as soon as the rise in the percentage of volatile fatty acids starts there is a sudden fall in the iodine value, lasting till the end of the experiments.

This sudden fall is perceptible in nearly all the returns. In order to explain this more clearly, I present here a table giving the first six series of the average of two succeeding weeks (to eliminate in this way the weekly fluctuations) as well as the saturation figures of the volatile fatty acids and of the iodine value.

We thus obtain numbers giving the composition fortnightly. We plainly notice the sudden fall of the iodine values at the very same moment as the rise of the percentage of volatile fatty acids.

TABLE

1.		**2.**		**3.**		**4.**		**5.**		**6.**	
vol. fatty acids.	iodine value.	vol. fatty acids.	iodine value.	vol. fatty acids.	iodine value.	vol. fatty acids.	iodine value.	vol. fatty acids.	iodine value.	vol. fatty acids.	iodine value.
26.9	42.0	27.4	44.3	24.1	43.9	24.2	45.6	28.6	41.5	22.8	47.6
23.6	43.1	25.9	43.6	23.5	45.3	23.1	45.3	26.4	43.1	21.2	47.5
25.2	44.2	25.4	43.4	23.2	44.9	21.4	45.4	26.9	42.9	23.0	45.8
23.3	40.9	23.8	44.2	22.2	45.3	25.4	39.4	27.4	40.7	25.2	40.4
21.0	43.2	22.5	44.2	22.0	43.4	27.4	35.9	29.4	37.9	27.0	39.0
24.5	36.1	22.3	42.4	24.5	37.6	26.6	36.8	29.8	36.6	27.6	39.8
25.8	38.2	25.9	33.3	27.4	36.1	26.5	36.4	29.1	34.3	28.0	39.5
26.4	37.4	29.8	30.8	27.4	37.4	27.6	34.6	32.0	32.3	28.1	38.9

We can see plainly that the iodine value does not bear any relation to the percentage of volatile fatty acids when comparing butters of the same saturation capacity of volatile fatty acids of the first months to those of the last months. Thus, for instance, we find on Table 1 as well for samples No. 49 as for No. 346, as regards volatile fatty acids 25.4, while the iodine value is respectively 43.1 and 66.1. In list No. 2, No. 50 and No. 400 (also 33 and 407 on Table No. 5) we find for volatile fatty acids 27.0 and 27.1, but as iodine value 42.6 and 33.6; this symptom may be found on all the tables.

The refractometer figure likewise shows peculiar differences. In general it falls when the percentage of volatile fatty acids rises, and rises when the percentage of volatile fatty acids falls; but we find no fixed proportion. Nearly the same symptom presents itself here as we found with the iodine value, and likewise we see here that butters vary in this respect during the first and the last months.

In the following instances this peculiarity is clearly demonstrated:—

Sample number ...	49	346	50	400	33	407
Volatile fatty acids ...	25.4	25.4	27.0	27.1	29.6	29.4
Refractometer numbers	42.5	41.0	43.1	40.0	42.0	39.9

Having proved that there are variations in the composition of butter, we will now see whether there are indications pointing towards their causes.

Technical literature gives, as the most influential factor dominating the composition of butter, the course of the lactation period. According to the accepted opinion, the percentage of butter as to volatile fatty acids decreases with the progress of the lactation period; and consequently, we should have to observe a decline from the beginning of the experiment till the time when the cows, having lately calved, again supply milk for butter-making purposes.

We really note a progressive falling off from September till a certain time in October or November, after that a considerable rise occurs; from this we should now be inclined to surmise that some of the cows had calved, and that to this circumstance the rise of the percentage of volatile fatty acids in butter was due. But, it will be seen from the particulars added to the returns (tables), that in nearly all cases the cows were not to throw calf before December or the early months of the next year, while the rise of the percentage of volatile fatty acids dated already from the months of October and November. We should have expected a decrease of the percentage of volatile fatty acids under the influence of the lactation period, for all cows are nearing the period when they will become dry. Consequently there must be another cause for the sudden rise in the percentage of volatile fatty acids, and if we compare the dates on which the rise commences with the dates given for the change of food and return to the stable, we find that **the rise begins shortly after the cows have been stabled. This is observed in all cases, and is very remarkable, because until now it has not been observed, or rather escaped notice.**

Shortly after the observations made by me, Stein and Böggil published a treatise concerning their experiment in Denmark.

I deem it desirable to discuss this treatise somewhat closely as regards the results of the experiments made during the autumn of 1896 at Brattingsborg, to ascertain in how far the low percentage of volatile fatty acids in butter must be attributed to one of the following causes :—

1. The far advanced lactation period in which the cows found themselves.
2. To the unfavourable autumn temperature.
3. To the insufficient food with which the cows, as a rule, have to be satisfied during the final period of the grazing season.

From the results, obtained by accurate experiments, the authors arrive at the following conclusions :—

1. No regular change can be stated as a consequence of the difference in food.
2. The low degree of volatile fatty acids in butter becomes specially prominent towards the end of the lactation period.
3. As a rule circumstances like cold, wet, feeding on wet grass, etc., which usually make their influence felt in the autumn, cause a decrease of the percentage of volatile fatty acids.

4. Strengthening fodder is not capable of raising the low percentage of volatile fatty acids in the butter of the cows that are running in the meadow in springtime.

When studying the numbers given by Böggild and Steyn, the correctness of the first three conclusions appears to be beyond doubt, but it seems to me that no sufficient ground exists for the fourth, and that, on the contrary, one may assume with quite as much right, if not more, that with the experiments made by Böggild and Steyn, the nutrition has exercised a plainly perceptible influence.

In technical works, we find various particulars from which the same tendency may be deduced, without the authors themselves being aware of it. Thus, for instance, it is quite plain from the experiments by Schrodt and Henehold, that the stabling has, as consequence, the rise of the percentage of volatile fatty acids in butter. Likewise there must be a connection in Wilson's experiments, between the stabling and the percentage of volatile fatty acids.

I desire to point out in the foregoing, that the observed change in the composition of butter, occurring after the stabling, can be verified, not only from my figures, but also from those of others. After a great many analyses of butters of cows of different breed, under different conditions of treatment and nourishment in different parts of Holland, the fact has undoubtedly been established that the stable-life exercises a very favourable influence on the degree of volatile fatty acids as compared to the grazing-time during the last months of the year.

But the word "stable-life" is here a collective conception, in so far as, concurrently with the transfer of the cows from the meadows to the stable, other changes take place. In the first place, the cows are being brought under totally different circumstances of temperature, dampness and exercise, while in the second place, the nourishment is changed and improved. The great question, therefore, is which of these two circumstances exercise their influence, or whether we must reckon with both of them. To be quite positive that the observed symptoms could not be attributed to casual influences accidentally existing during the proof year, I went on with the experiments for another year in four different stables. But in the second year also, the observed symptoms in the composition of butter were perfectly analogous to those of the first year. The fact was thus firmly established, that in those parts where the cows are exposed to a late pasturage, as in Friesland, Groningen and a few other provinces, the butter made during the autumn is of an abnormal composition.

If this conclusion be correct, then we ought to find no abnormal properties in butter made in those parts where pasturage is an exception to the cow. Fortunately, Holland offers in this respect a great variety; thus, it was only natural to institute an analysis in the composition of butter manufactured in October and November in those parts where cows are stabled overnight practically during the whole year, and are only by way of exception allowed to graze in the meadow during the day.

This is the case in the provinces of Limburg and North Brabant; the cows are there, as regards the influences of the weather, under much more favourable circumstances than the cows in the northern parts of Holland.

Hence I have collected 166 samples of butter, made in 166 co-operative manufactories in all parts of the above-mentioned two provinces. The samples were taken in the latter part of October or the beginning of November, consequently, during a time when the northern provinces of Holland produce the greatest deviation in the composition of butter.

Of all the samples the percentage of volatile fatty acids was defined. As was expected, no butter was found with an abnormally low percentage of volatile fatty acids; on the contrary, the saturation figure was, as a rule, very high.

The saturation figure of volatile fatty acids was as follows for various samples:—

Number of Samples.	Saturation figure of the vol. fat. acs.
0	below 28
5	28–28.9
20	29–29.9
70	30–30.9
62	31–31.9
9	32–33.0
166	

As could be expected, we find a remarkable contrast with the result of the analyses of butter samples from the more northern provinces of Holland, where cows sleep out and graze. A saturation figure above 28 in butter samples from the northern provinces was a great exception, whilst in the butter samples from Limburg and North Brabant butter with a saturation number under 28 does not exist at all. During October and the beginning of November for the butters of the northern provinces, not one figure was found higher than 29 and during November only for 4.5 per cent. of the analysed samples, against 85 per cent. of the samples from Limburg and North Brabant yielding more than 30; some even went to about 33.

I can now conclude, having established for a certainty that the abnormal chemical composition of Dutch butter during the autumn must be attributed to the circumstance that the farmers leave their cattle in the meadows until late in the year. I have also proved that an earlier stabling prevents the calling into existence of the abnormal composition under discussion. Of course we must understand the expression "stabling" as a collective idea, as, with the transfer of the cows to the stable, two principal factors are being modified. In the first place, the cows are being differently and more efficiently fed; in the second place, they are free from the influences of the weather and temperature, which are in full swing when they remain in the meadows. I did not succeed by experiments in ascertaining with certainty whether both factors play an equal part, or whether the influence must be attributed to one solely, or to one in greater measure than the other.

In conclusion, I wish to point out, as of practical interest, that the observed deviation in the composition of butters shows itself in all chemical and physical directions investigated by me. *These experiments, consequently, have again shown with great certainty that no one has the right, on the ground of the chemical and physical experiment only, to pronounce a decided opinion as to the adulteration or non-adulteration of a product offered as butter as long as analytical results did not pass limits far below the figures now accepted by most chemists.* The great variations in the composition of butter render it impossible for any expert to even approximately fix the percentage of adulteration so long as control over the churning of the original unadulterated product does not give positive knowledge of its composition before adulteration.

I emphatically point this out, because, especially during the last years, it has repeatedly occurred that experts charged with the analysis of butter did not seem to share this opinion. I hope that my present essay may serve to assist the analysts to be more just in their opinion of the Dutch butter.

It is not my intention to say that all products imported from Holland and showing an abnormal composition must be regarded as pure butter, for we ourselves are only too thoroughly convinced of the existence of unscrupulous impostors, who take advantage of the fact that pure natural butter can be of abnormal composition in order to introduce mixtures of normal butters and margarine as pure butter. Neither is it my intention to urge anyone to accept in the analysis of butter a low figure for the percentage of volatile fatty acids, for this would only result in aiding frauds. I only intended to prove from a purely scientific standpoint that butter with an abnormal composition may be pure, and that it is desirable, should abnormally low figures be found while experimenting, to test genuineness in a different manner, for instance by churning.

As far as the suppression of fraud in the butter trade is concerned, both the Dutch Government and private societies will give powerful aid. On the 1st of April, 1901, a new butter law came into force in Holland, taking strong measures to prevent the export of adulterated butters. The societies of butter and cheese makers exert all their power to furnish severe control, absolutely guaranteeing genuineness; and means are under deliberation to prevent butter of abnormal composition being introduced into the trade. Thus it is hoped that united efforts will succeed in rendering adulteration of butter impossible through stringent measures taken in the country itself to maintain the reputation for Dutch dairy produce.

Dr. J. J. L. van RYN.

No. 1.

Number of Cows: 30. Breed: Frisian.

Age: 7 of 2 years, 6 of 3 years, 9 of 4–5 years, 8 of 5–8 years.

Calved: 8 in February, 13 in March, 8 in April, 1 in May, 1896.

Approximate Calving time: 8 in February, 10 in March, 5 in April, 2 in May, 1897. 5 Heifers.

Soil of Meadow: sand ground.

Food:

9 September — 2 November: meadow.

2 November — 21 December: hay, linseed cake and maizemeal.

Stabled: Between 2 — 9 November.

Observation: In October and November 1 cow sold each time.

Number.	DATE.	Refractometer at 45° C.	Specific Weight at 37,8°C.	Volatile Acids Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Value Kottsdorfer.	Iodine Value Hübl.
26	7 September	42.1	0.9118	28.8	88.7	5.4	221.3	40.9
49	14 „	42.5	0.9117	25.4	89.1	4.9	—	43.1
80	21 „	43.0	0.9114	26.7	89.0	4.9	219.3	42.5
110	28 „	43.3	0.9118	24.5	89.6	4.7	217.3	43.7
136	5 October	42.2	0.9111	25.5	89.3	4.8	221.1	43.6
166	12 „	43.5	0.9108	24.9	89.7	4.7	218.1	44.7
201	19 „	43.5	0.9120	23.1	89.9	4.5	220.5	38.0
231	26 „	43.3	0.9105	23.5	89.6	4.5	216.3	43.8
259	2 November	43.5	0.9102	20.7	90.3	4.1	216.7	44.4
288	9 „	43.0	0.9108	21.2	90.5	3.9	214.3	42.1
319	16 „	41.2	0.9112	23.6	89.4	4.6	222·4	36.0
346	23 „	41.0	0.9118	25.4	89.2	4.8	221.3	36.1
372	30 „	41.2	0.9112	25.6	89.6	4.9	222.2	38.4
399	7 December	41.1	0.9110	26.0	89.4	5.0	220.0	38.1
423	14 „	41.3	0.9114	26.3	89.0	4.9	221.0	37.6
451	21 „	41.0	0.9113	26.5	89.1	4.9	221.6	37.2

Wed. K. I. Swart in *Harich.*

No. 2.

Number of Cows: 35. Breed: Frisian.

Age: 15 of 2–3½ years, 20 of 4–8 years.

Calved: 5 in March, 19 in April, 3 in May, 1 in June, 1896.

Approximate Calving time: 2 in March, 18 in April, 2 in May, 2 in June, 1897.
8 Heifers.

Soil of Meadow: sand ground.

Food:

7 September—22 November: meadow.

22 November—5 December: hay.

5 December: hay and maizemeal.

Stabled: Between 16—22 November.

Observations: 12 October 2 cows were put in the stable and fed on hay.

In November 3 cows were sold.

Number.	DATE.	Refractometer at 45° C.	Specific Weight at 37,8° C.	Volatile Acids Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Value Kottsdorfer.	Iodine Value Hübl.
27	7 September	42.3	0.9113	27.7	88.8	5.1	221.3	46.1
50	14 „	43.1	0.9114	27.0	88.9	5.1	223.6	42·6
81	21 „	42.8	0.9116	26.8	88.8	5.1	218.9	43.3
111	28 „	42.7	0.9108	24.9	89.6	4.8	217.0	43.9
137	5 October	42.5	0.9116	26.5	89.3	5.0	221.6	42.6
167	12 „	43.2	0.9110	24.2	89.5	4.6	218.5	44.3
202	19 „	43.6	0.9109	22.5	89.9	4.4	218.2	45.0
232	26 „	42.2	0.9108	25.0	89.0	4.8	217.6	43.5
260	2 November	43.5	0.9107	22.4	90.1	4.3	215.3	44.6
289	9 „	43.2	0.9107	22.5	90.2	4.2	216.0	43.9
320	16 „	43.3	0.9105	22.5	90.1	4.2	217.3	43.9
347	23 „	42.3	0.9114	22.2	90.2	4.1	215.0	41.0
373	30 „	40.3	0.9115	24.6	89.5	4.7	222.9	33.1
400	7 December	40.0	0.9116	27.1	88.9	5.2	226.0	33.6
424	14 „	40.8	0.9117	29.6	88.4	5.6	227.3	30.6
452	21 „	41.0	0.9123	29.9	88.4	5.5	227.1	31.0

K. I. Tromp in *Harich.*

No. 3.

Number of Cows : 33. Breed : Frisian.

Age : 11 of 2½ years, 10 of 3½ years, 12 of 4–6 years.

Calved : 22 from 12 January—3 March, 11 from 4 March—15 May, 1896.

Approximate Calving time : 22 from 1 February—5 March, 11 from 6 March—15 May, 1897.

Soil of meadow : clay ground.

Food :

8 September—1 November : meadow.

1 November—8 November : meadow, and 10 cows in the stable ⅔ grass, ⅓ hay.

8 November—22 December : ½ hay, ½ ensilage and linseed cake.

Stabled : 1 November 10, and the rest 8 November.

Number.	DATE.	Refractometer at 45° C.	Specific Weight at 37,8°C.	Volatile Acids Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Value Kottsdorfer.	Iodine Value Hubl.
30	8 September	43.2	0.9109	24.4	89.7	4.6	218.1	43.8
61	15 ,,	43.0	0.9111	23.8	89.9	4.4	217.9	44.1
85	22 ,,	43.5	0.9113	24.3	89.6	4.4	216.3	45.3
114	29 ,,	43.5	0.9104	22.6	90.0	4.3	213.4	45.3
142	6 October	43.5	0.9109	23.2	89.6	4.4	216.1	44.9
171	13 ,,	43.7	0.9104	23.1	89.5	4.5	217.5	44.9
206	20 ,,	43.8	0.9111	22.5	90.0	4.5	216.7	45.5
238	27 ,,	42.7	0.9101	21.8	92.0	4.4	215.1	45.2
264	3 November	43.2	0.9112	22.5	90.1	4.3	222.4	44.0
293	10 ,,	42.7	0.9106	21.4	90.2	4.1	215.1	42.9
324	17 ,,	41.7	0.9121	25.6	89.3	4.7	221.2	38.5
351	24 ,,	41.3	0.9119	24.4	89.3	4.7	221.8	36.7
380	1 December	40.5	0.9122	26.7	89.0	5.0	224.7	35.8
404	8 ,,	40.6	0.9121	28.0	88.7	5.2	224.7	36.5
428	15 ,,	40.2	0.9117	28.2	88.8	5.3	223.9	37.4
456	22 ,,	41.0	0.9117	26.6	89.1	5.1	223.7	37.5

K. Schuurmans in *Warga*.

No. 4.

Number of Cows: 26. Breed: Frisian.

Age: 8 of 2 years, 8 of 3 years, 10 of 4–6 years.

Calved: 9 in February, 14 in March, 3 in April, 1897.

Soil of Meadow: clay ground.

Food:

15 September—18 October: meadow.

18 October—10 November: $\frac{2}{3}$ grass, $\frac{1}{3}$ hay.

10 November—17 November: $\frac{1}{2}$ grass, $\frac{1}{2}$ hay.

17 November—22 December: $\frac{1}{3}$ grass, $\frac{2}{3}$ hay.

Stabled: 18 October.

Number.	Date.	Refractometer at 45° C.	Specific Weight at 37,8° C.	Volatile Acids Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Köttsdorfer.	Iodine Value Hübl.
62	15 September	43.8	0.9113	24.2	89.6	4.5	217.5	45.4
86	22 „	43.7	0.9109	24.1	89.7	4.5	216.6	45.8
115	29 „	43.7	0.9111	21.8	90.5	4.1	214.3	46.0
143	6 October	43.7	0.9114	24.3	89.5	4.6	219.4	44.7
172	13 „	43.7	0.9106	21.4	89.7	4.2	215.9	46.2
207	20 „	43.2	0.9104	21.4	90.3	4.2	220.6	44.6
237	27 „	41.9	0.9111	25.3	89.6	4.8	219.2	40.5
265	3 November	41.3	0.9117	25.4	89.2	4.9	223.0	38.3
294	10 „	40.2	0.9117	28.0	88.8	5.4	225.8	33.8
325	17 „	41.2	0.9119	26.8	88.4	5.1	223.0	37.9
352	24 „	41.2	0.9114	26.2	89.0	5.0	221.7	38.5
381	1 December	40.4	0.9123	27.0	88.9	5.1	224.5	35.1
405	8 „	41.4	0.9123	26.0	89.1	4.9	222.9	38.3
429	15 „	41.3	0.9120	27.9	88.8	5.2	226.8	34.6
457	22 „	40.6	0.9118	27.6	88.9	5.2	225.1	34.6

S. de Gavere in *Tjaard* near *Wirdum.*

No. 5.

Number of Cows: 14. Breed: Frisian.

Age: 3–10 years.

Calved: 12 from January—March, 2 in September, 1896.

Approximate Calving time: { 3 in December, 1896, 2 in January, 3 in February, 1 in March, 1897.

Soil of Meadow: clay ground.

Food:

9 September—20 October: meadow.

20 October—2 November: 2 cows meadow and 12 cows $\frac{2}{3}$ grass and $\frac{1}{3}$ hay.

3 November—21 December: $\frac{1}{2}$ hay, $\frac{1}{2}$ grass and linseed cake.

Stabled: 12 on 20 October, 2 on 3 Novemoer.

Number.	DATE.	Refractometer at 45° C.	Specific Weight at 37,8° C.	Volatile Acids Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner	Saponification Kottsdorfer.	Iodine Value Hübl.
33	9 September	42.0	0.9114	29.6	88.3	5.6	220.8	40.5
63	16 "	42.3	0.9114	27.5	88.7	5.1	223.6	42.6
91	23 "	42.6	0.9115	26.4	89.4	4.8	220.0	42.7
117	30 "	42.4	0.9107	26.3	89.5	4.9	217.3	43.6
146	7 October	43.0	0.9120	26.6	89.0	5.0	218.8	43.9
174	14 "	42.5	0.9121	27.1	88.8	5.2	224.9	41.9
209	21 "	42.2	0.9110	26.9	89.1	5.1	221.0	40.9
248	30 "	41.4	0.9000	27.8	88.4	5.5	224.4	40.6
267	2 November	41.2	0.9122	30.4	88.3	5.7	227.8	39.5
298	9 "	40.5	0.9120	28.4	88.6	5.4	225.3	36.4
327	16 "	40.2	0.9111	29.7	87.8	5.6	224.8	36.4
354	23 "	40.8	0.9119	29.9	88.4	5.7	224.7	36.8
383	30 "	40.0	0.9120	28.8	88.5	5.4	227.0	34.5
407	7 December	39.9	0.9120	29.4	88.1	5.5	226.8	34.1
433	14 "	39.7	0.9124	31.9	87.7	5.9	229.5	34.0
460	21 "	38.9	0.9128	32.1	87.6	6.2	229.4	30.6

H. H. van der Werf in *Bolsward.*

No. 6.

Number of Cows: 24. Breed: Frisian.

Age: 5 of 2 years, 4 of 3 years, 4 of 4 years, 1 of 5 years.

Calved: 4 in February, 6 in March, 3 in April,
1 in May, 1 in October, 1896.

Approximate Calving time: 2 in February, 6 in March,
4 in April,
2 Heifers. 1897.

Soil of Meadow: sand and peat (bog) ground.

Food:

17 September—28 October: meadow.

28 October—12 November: ⅔ spurge, ⅓ hay, and each 1 linseed cake.

13 November—24 December: hay, turnips, linseed and rapeseed cake.

Stabled: 28—29 November.

Observation: 15 October there was 1 cow that had calved, which was stabled, and fed on spurge, hay, linseed cake and boiled potatoes.

Number.	Date.	Refractometer at 45° C.	Specific Weight at 37,8° C	Volatile Acids Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Kottsdorfer.	Iodine Value Hübl.
68	17 September	44.1	0.9113	21.6	90.4	4.1	215.2	47.3
95	24 „	43.4	0.9112	22.3	90.5	4.1	214.6	48.0
122	1 October	44.6	0.9104	21.1	90.6	4.0	215.3	47.9
151	8 „	44.6	0.9108	21.3	90.1	4.2	212.8	47.1
183	15 „	43.5	0.9107	22.3	90.0	4.1	215.8	47.0
216	22 „	43.4	0.9108	23.6	89.8	4.7	217.9	44.7
244	29 „	42.5	0.9116	24.2	89.8	4.6	219.4	42.3
272	5 November	41.2	0.9118	26.2	89.1	5.3	222.1	38.6
301	12 „	41.3	0.9116	26.3	89.1	4.9	223.4	36.7
332	19 „	42.5	0.9120	27.6	88.7	5.2	221.7	41.4
358	26 „	41.1	0.9120	27.1	88.8	5.1	222.2	40.8
386	3 December	40.5	0.9118	28.0	88.9	5.2	224.5	39.3
411	10 „	41.5	0.9117	28.0	88.8	5.2	219.7	39.9
439	17 „	41.3	0.9117	28.0	88.8	5.2	222.2	39.2
463	24 „	41.4	0.9120	28.1	89.0	5.2	222.9	38.9

G. Venema in *Noord-Drachten.*

No. 7.

Number of Cows : 80—90. Breed : Frisian.

Soil of Meadow : sand, and peat (bog) ground.

Food :

Meadow, after 4 October many turnips.

Stabled : about 20—24 October.

Number.	DATE.	Refractometer at 45° C.	Specific Weight at 37,8° C.	Volatile Acids Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Kottsdorfer.	Iodine Value Hubl.
37	10 September	42.6	0.9119	28.0	88.9	5.2	221.6	44.1
69	17 ,,	42.4	0.9113	25.7	89.0	4.9	220.1	44.1
96	24 ,,	43.1	0.9116	26.5	89.1	4.9	219.0	45.0
123	1 October	43.6	0.9111	25.4	89.6	4.7	219.2	45.2
152	8 ,,	43.2	0.9108	25.2	89.5	4.7	219.1	44.6
184	15 ,,	43.5	0.9112	24.9	89.5	4.9	220.2	45.4
217	22 ,,	43.0	0.9111	24.9	89.2	5.0	221.1	43.3
245	29 ,,	42.7	0.9110	23.6	89.8	4.7	218.5	42.2
273	5 November	41.2	0.9111	26.6	89.2	5.0	222.5	38.1
302	12 ,,	41.6	0.9118	26.7	89.0	5.2	225.8	34.7
333	19 ,,	41.1	0.9117	26.9	89.0	5.0	222.7	35.6
359	26 ,,	41.3	0.9115	25.6	89.2	5.2	221.5	37.4
387	3 December	41.1	0.9109	25.3	89.4	4.7	220.3	38.0
412	10 ,,	41.0	0.9111	26.9	89.2	5.0	220.6	38.2
440	17 ,,	41.2	0.9114	26.7	88.9	5.0	220.8	38.5
464	24 ,,	41.3	0.9111	25.4	89.4	4.8	220.2	37.5

A. Arends in *Ureterp-Vallaat.*

No. 8.

Number of Cows: 6. Breed: Groningue.

Age: 4 of 2 years, 1 of 3 years, 1 of 4 years.

Calved: 1 in February, 2 in March, 3 in April, 1896.

Approximate Calving time: 2 in March, 2 in April, 1897.
2 Heifers.

Soil of Meadow: clay ground.

Food:

11 September—9 October: meadow.

9 October—20 November: straw and beetroot leaves.

20 November—27 November: hay and ensilage.

Stabled: 9 October.

Observation: 6 November only 3 cows are milked,
27 November all of them are dry.

Number.	DATE.	Refractometer at 45° C.	Specific Weight at 37,8°C.	Volatile Acids. Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Kottsdorfer.	Iodine Value Hübl.
41	11 September	43.6	0.9119	24.5	89.4	4.6	219.9	48.3
73	18 „	44.1	0.9108	21.0	90.2	4.1	216.1	47.9
100	25 „	43.8	0.9109	23.1	89.9	4.4	217.1	45.7
131	2 October	44.5	0.9115	23.6	89.7	4.6	219.7	46.4
157	9 „	43.3	0.9112	21.8	90.0	4.2	218.3	44.9
188	16 „	42.7	0.9104	21.3	90.3	4.0	219.0	43.0
221	23 „	41.2	0.9108	23.3	89.6	4.7	220.7	38.0
250	30 „	40.5	0.9110	23.4	89.6	4.7	222.8	34.4
278	6 November	40.6	0.9118	24.6	89.1	4.8	226.6	31.0
306	13 „	40.0	0.9111	24.9	89.5	4.8	225.1	31.7
337	20 „	41.8	0.9111	23.6	89.9	4.3	217.8	36.4
365	27 „	40.5	0.9111	21.0	90.2	4.0	219.9	32.8

F. Heidema in *Warfum.*

No. 9.

Number of Cows: 7. Breed: Groningue.

Age: 3 of 2 years, 4 of 3 years.

Calved: from February—April, 1897.

Soil of Meadow: clay ground.

Food:

11 September—22 October: meadow.

22 October—30 October: greens and linseed cake.

30 October—20 November: greens, turnips, hay and linseed cake.

20 November—4 December: turnips, hay, linseed cake and meal.

4 December—11 December: turnips, hay and meal.

Stabled: 22 October.

Number.	DATE.	Refractometer at 45° C.	Specific Weight at 37,8°C.	Volatile Acids Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Kottsdorfer.	Iodine Value Hübl.
42	11 September	44.5	0.9114	24.4	89.9	4.4	216.9	44.9
74	18 „	44.8	0.9109	21.4	90.3	4.0	217.3	47.8
101	25 „	45.1	0.9109	21.1	90.5	4.0	218.1	47.2
132	2 October	45.0	0.9102	20.3	90.6	4.0	214.2	49.1
158	9 „	44.6	0.9108	19.7	90.7	3.9	214.5	47.5
189	16 „	45.0	0.9112	20.3	90.6	4.0	215.9	48.8
222	23 „	45.3	0.9113	19.0	90.7	3.8	212.0	49.2
251	30 „	44.0	0.9105	19.2	91.0	3.8	212.9	46.6
277	6 November	42.6	0.9108	21.5	90.3	4.0	218.3	41.9
307	13 „	42.4	0.9107	22.2	90.2	4.1	217.8	41.3
338	20 „	42.3	0.9112	23.1	90.1	4.2	209.0	44.5
366	27 „	40.9	0.9114	25.2	89.3	4.6	224.0	36.1
391	4 December	40.4	0.9112	24.7	89.2	4.6	224.9	35.6
416	11 „	40.2	0.9111	25.4	89.2	4.9	224.5	34.2

W. Willemsen in *Warfum.*

No. 10.

Number of Cows: 3. Breed: Drenth.

Age: 1 of 2 years, 1 of 3 years, 1 of 4 years.

Calved: in the spring of 1896.

Approximate Calving time: 2 in the spring of 1896, 1 Heifer.

Soil of Meadow: sand ground.

Food:

12 September—3 October: meadow.

10 October—15 November: hay, turnips and linseed cake.

15 November—19 December: hay and linseed cake.

10 October—7 November: spurge at night.

Stabled: 7 November, since the 3 October all the cows are in the stable.

Observation: After 7 November only 2 cows are milked.

Number.	DATE.	Refractometer at 45° C.	Specific Weight at 37,8° C.	Volatile Acids Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Kottsdorfer.	Iodine Value Hübl.
44	12 September	43.1	0.9110	24.4	89.5	4.7	217.8	43.0
76	19 "	43.3	0.9108	24.5	89.5	4.6	215.5	44.6
105	26 "	44.1	0.9104	22.4	89.9	4.3	215.3	45.4
161	10 October	43.5	0.9110	23.4	89.7	4.5	217.1	45.4
195	17 "	43.2	0.9108	23.8	90.0	4.5	217.4	43.9
227	24 "	43.0	0.9105	24.4	89.5	4.8	216.3	43.5
255	31 "	43.6	0.9105	23.5	90.0	4.5	214.5	44.6
281	7 November	43.5	0.9109	22.3	90.1	4.2	213.4	44.5
309	14 "	43.6	0.9111	21.1	90.5	4.0	213.9	43.8
341	21 "	43.4	0.9113	20.9	90.6	4.0	212.1	45.0
368	28 "	43.6	0.9114	20.0	90.7	4.0	212.9	44.5
393	5 December	43.7	0.9108	21.0	90.5	3.9	210.8	44.9
418	12 "	43.5	0.9112	21.4	90.4	4.0	212.9	45.6
445	19 "	43.7	0.9110	22.3	90.3	4.2	215.6	45.2

H. Venema in *Rogat* gem. *de Wijk*.

No. 11.

Soil of Meadow : sand ground.

Cows stabled about the latter part of October

Number.	Date.	Refractometer at 45° C.	Specific Weight at 37.8° C.	Volatile Acids Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Kottsdorfer.	Iodine Value Hübl.
28	7 September	42.4	0.9115	26.8	89.0	4.9	218.8	42.5
51	14 „	43.2	0.9111	24.9	89.4	4.8	220.8	43.1
82	21 „	43.3	0.9110	25.8	89.5	4.8	219.3	43.7
112	28 „	43.5	0.9108	23.0	89.9	4.4	216.1	44.1
138	5 October	42.9	0.9110	24.5	89.6	4.6	218.6	43.5
168	12 „	43.9	0.9105	22.6	90.2	4.4	215.7	45.2
203	19 „	43.5	0.9107	22.3	90.0	4.5	216.2	45.3
233	26 „	42.8	0.9110	24.0	89.7	4.7	218.4	43.5
261	2 November	43.0	0.9112	23.5	89.8	4.3	216.4	43.6
290	9 „	42.0	0.9107	23.6	89.7	4.4	219.4	39.6
321	16 „	41.6	0.9112	23.4	89.8	4.4	221.0	38.8
348	23 „	41.2	0.9112	24.8	89.6	4.6	220.7	37.1
374	30 „	40.7	0.9112	25.4	89.6	4.9	223.5	36.0
401	7 December	40.6	0.9119	25.6	89.3	4.8	223.2	36.2
425	14 „	40.8	0.9117	26.2	89.2	4.9	220.5	36.8
453	21 „	41.0	0.9112	26.5	89.0	4.9	221.2	36.6

Kaas- en Roomboterfabriek in *Sloten*, Dir. J. J. Huisman.

No. 12.

Soil of Meadow : sand ground.

Stabled : 4—12 November.

Number.	DATE.	Refractometer at 45° C.	Specific Weight at 37,8° C.	Volatile Acids Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Kottsdorfer.	Iodine Value Hübl.
29	7 September	42.4	0.9111	27.0	89.0	5.1	218.4	43.0
52	14 ,,	43.1	0.9111	24.8	89.4	4.8	220.7	42.9
85	21 ,,	43.1	0.9114	26.0	89.5	5.0	216.8	42.9
113	28 ,,	43.1	0.9109	24.5	89.6	4.6	220.4	43.5
139	5 October	42.8	0.9113	24.8	89.2	4.8	221.7	43.7
169	12 ,,	43.8	0.9103	23.1	90.1	4.5	215.8	45.8
204	19 ,,	43.5	0.9111	22.3	89.8	4.2	216.9	46.6
234	26 ,,	43.3	0.9109	23.7	89.9	4.5	216.9	45.3
262	2 November	43.3	0.9111	21.5	90.3	4.2	216.0	44.5
291	9 ,,	42.3	0.9110	24.2	89.5	4.6	219.2	41.5
322	16 ,,	41.6	0.9115	24.8	89.3	4.7	222.8	37.5
349	23 ,,	41.2	0.9118	24.8	89.3	4.6	221.8	35.9
375	30 ,,	41.2	0.9115	25.6	89.2	4.9	223.6	36.6
402	7 December	40.9	0.9111	25.6	89.1	4.9	222.9	37.1
426	14 ,,	41.1	0.9114	26.8	88.9	5.0	223.8	36.7
454	21 ,,	40.8	0.9115	25.9	89.2	4.9	222.8	36.2

Kaas- en Roomboterfabriek " de Eensgezindheid " in *St. Nicolaasga*,
Dir. B. Y. Agricola.

No. 13.

Soil of Meadow: clay and gravelly ground.

Stabled: About 1 November.

Fodder in the stable: generally ⅔ hay, ⅓ grass.

Number.	Date.	Refractometer at 45° C.	Specific Weight at 37,8° C.	Volatile Acids Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Kottsdorfer.	Iodine Value Hübl.
32	8 September	43.1	0.9116	26.1	89.2	4.8	217.5	46.6
64	14 „	43.7	0.9117	26.3	89.1	4.9	219.0	43.3
84	21 „	43.6	0.9115	25.0	89.7	4.6	217.9	45.8
141	5 October	43.6	0.9111	23.7	89.8	4.5	217.8	46.1
170	12 „	44.0	0.9111	23.0	89.5	4.4	217.4	46.7
205	19 „	43.6	0.9112	23.0	89.9	4.3	217.1	46.4
239	26 „	42.7	0.9107	24.6	89.5	4.7	218.9	43.3
263	2 November	42.3	0.9110	24.9	89.6	5.0	219.6	41.9
292	9 „	41.7	0.9116	26.6	89.1	5.0	223.6	39.5
323	16 „	41.7	0.9117	25.5	89.1	4.9	220.4	39.2
350	23 „	41.0	0.9116	26.0	89.0	4.9	221.1	38.0
379	30 „	41.0	0.9117	26.2	89.2	4.9	221.8	37.1
403	8 December	41.1	0.9118	26.7	89.1	4.9	224.1	38.5
427	14 „	40.8	0.9115	26.7	88.9	4.9	—	36.4
455	22 „	41.0	0.9115	27.5	89.1	5.0	221.0	37.6

Coöperatieve Kaas- en Roomboterfabriek in *Irnsum*,
Dir. H. B. Hijlkema.

NO. 14.

Soil of Meadow: peat (bog) and gravelly ground.

Stabled: 15 October—1 November.

Number.	Date.	Refractometer at 45° C.	Specific Weight at 37,8° C.	Volatile Acids. Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Kottsdorfer.	Iodine Value Hübl.
31	8 September	42.8	0.9115	26.9	88.8	5.1	221.1	45.0
87	22 "	43.1	0.9116	25.6	89.5	4.7	219.4	43.7
116	29 "	43.0	0.9110	23.7	90.0	4.5	218.1	44.3
144	6 October	42.6	0.9110	24.3	89.3	4.6	218.6	43.9
173	13 "	43.0	0.9111	24.2	89.8	4.7	218.8	44.0
208	20 "	42.9	0.9111	24.2	89.7	4.5	219.3	44.1
235	27 "	42.8	0.9108	24.0	89.7	4.5	219.7	43.9
266	3 November	42.5	0.9112	24.2	89.6	4.7	220.6	42,5
295	10 "	42.0	0.9113	24.6	89.5	4.9	221.2	39.4
326	17 "	41.8	0.9110	25.0	88.9	4.7	220.1	39.0
353	24 "	41.4	0.9114	25.8	89.3	4.8	222.6	38.4
382	1 December	41.3	0.9113	26.1	89.4	4.8	221.5	38.1
406	8 "	41.1	0.9119	26.5	89.3	4.9	221.7	38.9
430	15 "	41.7	0.9114	25.2	89.4	4.8	221.8	38.5
458	22 "	41.4	0.9115	27.2	89.0	5.1	221.6	38.1

Coöperatieve Kaas- en Roomboterfabriek in *Warga*, Dir. S. Kuiper.

No. 15.

Soil of Meadow: clay ground.

Stabled: First week in November.

Number.	DATE.	Refractometer at 45° C.	Specific Weight at 37,8° C.	Volatile Acids. Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Kottsdorfer.	Iodine Value Hübl.
34	2 September	42.6	0.9115	28.5	88.8	5.3	217.6	45.3
64	16 "	43.9	0.9120	26.1	89.2	4.9	219.0	43.3
92	23 "	43.0	0.9117	26.6	89.3	5.0	220.7	43.6
118	30 "	43.1	0.9115	25.6	89.4	4.7	219.3	43.8
147	7 October	43.0	0.9117	25.1	89.2	4.8	216.2	44.6
175	14 "	43.2	0.9111	24.7	89.3	4.8	219.9	44.0
210	21 "	42.6	0.9112	24.3	89.6	4.8	220.1	44.3
241	28 "	43.0	0.9120	25.5	89.4	4.9	218.9	41.1
268	4 November	41.3	0.9118	26.6	88.8	5.1	223.3	39.3
296	11 "	40.8	0.9120	28.2	88.8	5.4	224.2	35.9
328	18 "	40.5	0.9120	28.0	88.9	5.1	225.4	35.7
355	25 "	40.3	0.9117	28.0	88.7	5.1	225.6	34.7
384	2 December	40.3	0.9120	27.7	88.8	5.3	226.6	34.8
408	9 "	39.9	0.9119	28.5	88.4	5.4	225.9	34.5
434	16 "	39.9	0.9120	28.8	88.6	5.4	227.9	33.7
461	23 "	40.6	0.9118	28.7	88.7	5.3	226.1	34.3

Kaas- en Roomboterfabriek in *Bolsward*, Dir. F. H. Kingma.

No. 16.

Soil of Meadow: clay and gravelly ground.

Stabled: last week of October.

Number.	Date.	Refractometer at 45° C.	Specific Weight at 37,8°C.	Volatile Acids Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Kottsdorfer.	Iodine Value Hübl.
36	9 September	43.0	0.9114	26.3	89.2	4.8	219.1	45.1
66	16 "	43.2	0.9118	25.9	89.2	4.8	220.3	43.4
94	23 "	44.6	0.9109	25.3	89.5	4.9	217.7	44.8
120	30 "	43.5	0.9112	24.4	89.8	4.5	219.1	44.5
149	7 October.	43.7	0.9114	24.7	89.7	4.6	219.3	44.8
177	14 "	43.4	0.9117	24.5	89.2	4.6	219.1	45.8
211	21 "	42,7	0.9113	24.8	89.6	4.8	218.5	44.0
242	28 "	42.6	0.9113	24.1	89.6	4.8	219.7	43.1
269	4 November	41.7	0.9114	25.5	89.3	4.9	221.7	40.2
297	11 "	41.5	0.9118	26.8	89.0	5.0	222.7	37.9
329	18 "	41.1	0.9117	26.0	89.0	4.9	223.3	37.9
356	25 "	40.7	0.9114	26.8	88.8	5.0	224.5	35.8
385	2 December	40.7	0.9115	26.4	89.1	4.9	222.6	36.2
409	9 ".	40.8	0.9119	27.7	88.6	5.2	224.2	37.1
435	16 "	43.7	0.9117	27.6	88.8	5.2	225.0	36.9
462	23 "	39.9	0.9118	27.5	88.9	5.1	223.1	36.5

Kaas- en Roomboterfabriek in *Sneek*, Dir. C. L. van Hoorn.

No. 17.

Soil of Meadow: sand and peat (bog) ground.

Stabled: last week of October.

Number.	DATE.	Refractometer at 45° C.	Specific Weight at 37,8°C.	Volatile Acids Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Kottsdorfer.	Iodine Value Hübl.
38	10 September	43.2	0.9117	27.1	88.8	5.1	219.9	44.1
70	17 ”	43.9	0.9111	25.5	89.5	4.8	219.1	44.2
97	24 ”	43.3	0.9109	25.3	89.4	4.7	220.1	45.0
124	1 October	43.5	0.9107	24.1	89.7	4.5	219.0	44.6
153	8 ”	43.2	0.9108	23.9	89.7	4.6	217.7	45.5
185	15 ”	43.5	0.9107	23.2	90.0	4.5	217.2	46.2
218	22 ”	42.9	0.9113	24.2	89.5	4.7	219.3	42.7
246	29 ”	42.9	0.9112	23.1	89.9	4.3	217.0	43.5
274	5 November	42.0	0.9115	24.7	89.6	4.7	219.7	40.8
303	12 ”	41.5	0.9115	28.3	88.9	5.3	223.8	39.2
334	19 ”	41.3	0.9120	26.1	89.2	4.9	221.7	39.0
360	26 ”	41.3	0.9116	26.0	89.0	5.0	222.3	38.5
388	3 December	41.3	0.9116	25.6	89.3	4.8	221.5	39.1
413	10 ”	41.2	0.9114	26.7	89.1	5.0	222.1	38.1
441	17 ”	41.2	0.9114	26.3	89.2	5.0	221.0	38.9
465	24 ”	41.7	0.9110	25.9	89.4	4.8	221.0	38.8

Kaas- en Roomboterfabriek “de Hoop” in *Olterterp*, Dir. E. de Graaf.

No. 18.

Soil of Meadow : sand and peat (bog) ground.

Stabled : 15—22 October.

Number.	DATE.	Refractometer at 45° C.	Specific Weight at 37,8°C.	Volatile Acids Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Kottsdorfer.	Iodine Value Hübl.
39	10 September	42.6	0.9109	27.2	88.8	5.0	221.7	45.0
71	17 „	42.6	0.9116	25.9	89.0	4.8	220.6	42.6
98	24 „	42.5	0.9109	25.8	89.3	4.9	220.5	42.5
125	1 October	42.6	0.9113	25.8	89.3	5.0	221.7	42.9
154	8 „	43.2	0.9111	23.8	89.4	4.7	218.4	44.7
186	15 „	42.6	0.9103	25.0	89.5	4.9	220.9	43.3
219	22 „	41.2	0.9111	24.8	89.4	4.8	223.2	37.9
247	29 „	41.7	0.9116	26.5	89.2	4.9	222.6	39.0
275	5 November	41.2	0.9116	26.4	89.2	4.9	222.8	36.8
304	12 „	40.7	0.9119	28.4	88.8	5.3	226.7	35.4
335	19 „	41.0	0.9117	27.6	88.8	5.0	223.0	37.7
361	26 „	40.7	0.9117	25.7	89.0	5.0	221.9	36.2
389	3 December	41.0	0.9117	26.4	89.2	4.8	223.1	38.3
414	10 „	40.8	0.9115	27.5	88.8	5.1	224.4	36.5
442	17 „	41.0	0.9115	26.9	89.1	5.1	222.9	36.9
466	24 „	40.4	0.9111	26.8	89.1	5.1	221.0	36.8

Roomboterfabriek “ deEendracht ” in *Opeinde*, Dir. L. Bosma.

No. 19.

Soil of meadow: heavy clay ground.

Stabled: Last week of October.

Number.	DATE.	Refractometer at 45° C.	Specific Weight at 37,8° C.	Volatile Acids. Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Kottsdorfer.	Iodine Value Hübl.
40	11 September	43.9	0.9114	24.2	89.6	4.6	218.7	48.9
72	18 „	43.8	0.9111	22.3	90.3	4.4	217.8	47.5
99	25 „	42.3	0.9109	22.0	90.2	4.1	214.8	48.1
130	2 October	43.7	0.9113	22.2	90.0	4.2	217.8	45.8
156	9 „	44.6	0.9105	21.5	90.2	4.0	215.0	46.5
187	16 „	42.7	0.9118	23.3	90.3	4.6	219.9	42.2
220	23 „	41.7	0.9113	25.6	89.2	5.0	221.1	41.3
249	30 „	40.8	0.9116	25.3	89.2	5.0	223.6	36.3
279	6 November	40.1	0.9116	26.0	89.0	4.9	223.7	35.1
305	13 „	40.2	0.9118	27.5	88.8	5.1	225.8	34.2
336	20 „	40.2	0.9118	27.7	89.0	4.9	225.8	34.8
364	27 „	40.5	0.9119	27.5	88.9	5.0	223.9	34.8
390	4 December	39.9	0.9117	27.4	88.8	5.0	224.9	35.6
415	11 „	40.7	0.9117	27.8	88.6	5.2	225.4	35.8
443	18 „	40.4	0.9117	28.6	89.0	5.3	226.9	36.0

Roomboterfabriek “de Concurrent” in *Usquert*, Dir. G. Wolters.

No. 20.

Soil of Meadow: clay ground.

Stabled: Last week of October.

Number.	Date.	Refractometer at 45° C.	Specific Weight at 37,8° C.	Volatile Acids. Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Kottsdorfer.	Iodine Value Hübl.
43	11 September	44.3	0.9116	23.3	90.1	4.5	219.1	50.3
75	18 "	44.0	0.9110	24.6	90.0	4.5	209.8	47.3
102	25 "	44.3	0.9114	23.2	89.6	4.4	218.6	47.2
133	2 October	44.0	0.9112	22.9	90.0	4.3	219.9	46.2
159	9 "	43.3	0.9111	21.6	90.2	4.1	217.5	46.3
190	16 "	43.1	0.9113	22.5	89.9	4.3	218.9	43.2
223	23 "	42.0	0.9106	23.4	89.8	4.6	217.0	42.9
252	30 "	41.2	0.9112	24.7	89.3	5.0	222.5	37.8
276	6 November	41.0	0.9109	24.8	89.5	4.6	223.9	37.9
308	13 "	41.2	0.9113	25.1	89.2	4.8	222.3	31.5
339	20 "	41.0	0.9117	26.3	89.3	5.0	224.2	36.6
367	27 "	39.6	0.9118	26.6	89.4	4.9	223.3	36.6
392	4 December	42.2	0.9112	25.2	89.3	4.8	221.4	39.0
417	11 "	40.8	0.9118	27.5	89.1	5.1	225.3	36.4
444	18 "	41.3	0.9116	26.5	89.3	4.9	222.4	38.3

Roomboterfabriek "Hunsingo" in *Baflo*, Dir. P. Dauma.

No. 21.

Soil of Meadow : sand ground.

Stabled : About 1 November.

Number.	DATE.	Refractometer at 45° C.	Specific Weight at 37,8° C.	Volatile Acids. Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Kottsdorfer.	Iodine Value Hübl.
45	12 September	43.5	0.9110	26.1	89.6	5.0	220.1	47.1
77	19 ,,	43.3	0.9118	24.8	89.4	4.8	219.2	45.0
106	28 ,,	44.0	0.9106	22.1	90.0	4.4	215.0	47.2
162	10 October	43.6	0.9106	23.7	89.8	4.4	216.9	46.6
196	17 ,,	44.8	0.9104	23.4	89.5	4.3	214.4	47.3
228	24 ,,	43.3	0.9108	24.4	89.3	4.6	214.9	45.2
256	31 ,,	43.6	0.9105	23.0	89.9	4.5	216.5	40.7
282	7 November	43.2	0.9107	21.1	90.1	4.4	216.5	45.5
310	14 ,,	43.3	0.9109	22.6	89.7	4.4	217.4	43.8
342	21 ,,	42.9	0.9113	23.3	90.1	4.4	216.6	43.3
369	28 ,,	42.6	0.9109	23.6	89.8	4.5	219.1	42.8
394	5 December	43.0	0.9111	24.3	89.5	4.6	218.6	44.0
419	12 ,,	42.7	0.9109	24.4	89.5	4.6	216.8	43.8
446	19 ,,	43.1	0.9110	25.4	89.3	4.9	216.9	44.0

Roomboterfabriek in *Rogat*. Dir. P. van Kleef.

No. 22.

Soil of Meadow : light sand ground.

Stabled : about 1 November.

Number.	DATE.	Refractometer at 45° C.	Specific Weight at 37,8° C.	Volatile Acids Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Kottsdorfer.	Iodine Value Hübl.
46	12 September	44.0	0.9110	24.1	89.9	4.7	217.6	48.4
78	19 „	43.6	0.9106	23.5	89.9	4.5	215.4	45.0
107	26 „	43.3	0.9109	23.3	90.0	4.3	216.4	44.5
163	10 October	43.7	0.9107	24.7	89.5	4.6	218.0	44.1
197	17 „	42.8	0.9107	23.3	89.7	4.5	217.1	43.9
229	24 „	42.2	0.9109	25.2	89.6	5.0	218.0	43.0
257	31 „	42.7	0.9109	23.2	89.7	4.8	217.0	43.5
283	7 November	43.0	0.9108	23.6	89.8	4.4	218.4	43.8
311	14 „	43.0	0.9109	23.7	89.4	4.5	218.5	43.6
343	21 „	42.7	0.9114	24.0	90.1	4.3	215.8	42.5
370	28 „	42.8	0.9111	23.1	90.2	4.3	217.8	42.6
395	5 December	43.0	0.9117	23.1	89.6	4.5	218.1	42.9
420	12 „	43.2	0.9107	23.5	89.8	4.4	216.1	44.4
447	17 „	43.3	0.9109	23.3	90.0	4.4	214.3	44.7

Roomboterfabriek at *Koekange*, Dir. K. van Lunzen Kzn.

No. 23.

Soil of Meadow: sand ground.

Stabled: 10—15 November.

During the summer the cows were brought to the stable for the night and then partly fed, partly not, with linseed cake, bread or meal, or something of the kind, while during September, October, and in the beginning of November they get chiefly spurge together with a little turnip-greens.

Calving time mostly February and March, some also December and January.

Number.	DATE.	Refractometer at 45° C.	Specific Weight at 37,8° C.	Volatile Acids Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Kottsdorfer.	Iodine Value Hübl.
47	12 September	43.8	0.9112	25.6	89.3	4.6	221.2	43.0
79	19 ,,	43.2	0.9109	24.3	89.9	4.6	217.2	45.1
108	26 ,,	43.8	0.9106	24.5	89.9	4.5	216.2	44.2
164	10 October	43.9	0.9106	26.5	89.2	4.8	220.4	43.1
198	17 ,,	42.3	0.9109	24.6	89.4	4.9	219.2	42.5
230	24 ,,	42.2	0.9118	27.4	89.0	5.1	220.9	40.9
258	31 ,,	41.8	0.9110	27.4	89.1	5.1	221.9	40.1
284	7 November	41.2	0.9116	27.7	88.9	5.1	223.4	39.7
312	14 ,,	41.6	0.9125	28.4	88.3	5.4	226.0	37.2
344	21 ,,	40.9	0.9117	28.4	89.0	5.1	223.7	37.1
371	28 ,,	41.1	0.9120	27.1	88.9	5.2	222.9	37.7
396	5 December	41.2	0.9115	27.1	88.8	5.1	222.3	38.7
421	12 ,,	40.4	0.9118	27.5	88.7	5.2	222.9	38.4
448	19 ,,	41.3	0.9117	28.0	88.8	5.3	224.1	37.3

Roomboterfabriek in *Beilen*, Dir. Gebrs. v. d. Bosch.

No. 24.

Number of Cows: 144. Breed: Frisian.

Age: from 2 to 7 years.

Calved: from November, 1895—September, 1896.

Soil of Meadow: clay ground.

Food:

15 September—10 October: meadow.

10 October—22 October: ± 40 cows cut grass and the others meadow.

22 October—2 November: cut grass.

2 November—10 November: $\frac{1}{3}$ hay, $\frac{2}{3}$ grass.

10 November—17 November: as above, a few cows with linseed cakes.

17 November: hay with linseed cake.

Stabled: ± 40 on 7 October, the rest on 22 October.

Number.	DATE.	Refractometer at 45° C.	Specific Weight at 37,8° C.	Volatile Acids Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Kottsdorfer.	Iodine Value Hübl.
59	15 September	43.3	0.9120	25.0			221.8	43.4
89	22 „	43.1	0.9116	26.5			219.9	43.9
126	29 „	42.8	0.9118	25.0			219.3	43.9
150	7 October	43.6	0.9111	23.3			217.1	45.0
191	16 „	43.9	0.9111	23.7			220.5	43.3
214	22 „	43.9	0.9111	21.6			215.9	47.3
240	28 „	42.0	0.9118	25.6			220.6	41.4
270	3 November	41.3	0.9115	26.8			223.1	38.3
299	11 „	40.3	0.9126	30.9			225.8	35.4
331	18 „	40.5	0.9120	28.2			223.8	36.5
357	25 „	40.6	0.9118	28.4			222.8	35.6
410	8 December	39.9	0.9123	30.0			226.3	35.0
459	23 „	39.7	0.9122	29.5			225.0	32.7

Zuivelschool in *Bolsward*, Dir. S. Westra.

No. 25.

Number of Cows: 6. Breed: Groningue.

Age: 4 of 2½ years, 2 of 3½ years.

Calved: 3 in February, 1 in March, 1 in April, 1 in May, 1896.

Soil of Meadow: gravelly clay ground.

Food:

2 October—4 November: meadow on old grass land.

4 November—18 November: hay and straw with meal of ground beans, barley and oats.

Stabled: 4 November, after the cows had been stabled overnight from 31 October.

Number.	Date.	Refractometer at 45° C.	Specific Weight at 37,8° C.	Volatile Acids Wollny.	Indissoluble Acids Hehner.	Dissoluble Acids Hehner.	Saponification Kottsdorfer.	Iodine Value Hübl.
134	2 October	45.5	0.9109	20.0			215.9	49.4
155	8 „	44.8	0.9108	20.0			216.3	47.9
200	15 „	44.4	0.9105	17.6			213.4	—
212	20 „	43.4	0.9109	22.6			219.0	45.5
253	29 „	44.2	0.9108	18.5			213.8	48.3
285	7 November	44.4	0.9100	17.0			212.2	—
330	18 „	41.5	0.9108	23.3			219.8	38.7

S. Huizenga, in *Middelstum.*

THE NEW BELGIAN BUTTER LAW

AND THE

BELGIAN ANALYSERS.

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In circles of those interested in the butter and cheese trade the introduction of the new Belgian butter law has during the last months been repeatedly a subject of argument, and that same law has caused much anxiety to our Dutch butter-makers. The cause lies not as much in the principle of the law, which aims at acting against adulteration, but more particularly in Art. 10, which contains a strong measure to prevent mixtures with small quantities of margarine, which cannot be exposed by analysis, being brought into the trade as pure butter. The difficulties presenting themselves at a chemical analysis, have not their ground in the imperfection of the methods available, but principally in the peculiar fact that the composition of butter obtained from cream or milk is not always nor everywhere the very same. We may say, like our butter law, "butter is that fat article, having no other fat parts but those originating from butter," but it is quite something else to describe professionally the exact composition of butter.

The law gives in Art. 1 only a definition of butter from the point of view of origin; it says that butter is a product acquired in such and such a way, but keeps of course silent on what is just the main point—how it is composed. This is impossible to say, because the composition depends on various circumstances; a cow is no machine into which something is poured from one side and which it leaves at the opposite side as an article of a certain stipulated composition.

It is, however, possible to influence the course of this process of interchange of material, but only within certain limits.

An important difference in composition between butter and margarine lies in the presence of volatile fatty acids. Butter contains a great quantity thereof, while margarine has hardly any volatile fatty acids at all.

Consequently, if one finds a product rich in volatile fatty acids, one contends it to be butter. In the opposite case it may be margarine or a mixture of butter and margarine.

However it is clearly imposible to fix the limit for the percentage of volatile fatty acids that must at least be found in butter; while butter, as I have already pointed out, varies in its composition, subject to the place from whence it came and to the weather. From this results, that on analysing butter one may meet with figures giving the percentage of volatile fatty acids which justify doubt as to whether one has to deal with pure natural butter or with a mixture of pure butter and margarine.

In order to raise this doubt the Belgian legislator has, in imitation of Germany, stipulated the use of sesamoil as compulsory, and moreover ordered an addition of fecula (starch food) to the margarine; thus rendering it possible to discover even very small quantities of such margarine in mixtures of butter.

Every adulteration with margarine prepared in Belgium itself can thus be discovered. Not so, however, an adulteration with margarine imported from Holland; and the Belgian law was consequently impotent to prohibit some mixtures of butter and margarine imported as butter from Holland.

To meet this difficulty Art. 10 of the law was introduced, stipulating to what chemical composition a product must answer in order to be brought into the trade as butter. By Royal Decree of 31st October, 1900, the figures were given and accepted as minimum (lowest) limits for pure butter. The question, therefore, was no longer, "What is the composition of butter as provided by the cow?" but they simply said, "A product not answering to the demands as put by us is no butter, not even when prepared from milk." It cannot astonish us that even in Belgium people rose to object against this silly rule; and I wish here to give an outline of a lecture given in the general meeting of the Belgian Chemici at

Brussels in January last, which meeting I attended as a member. Mr. J. Wauters, the general secretary, submitted the new Belgian butter law to a severe criticism.

The purpose of the projectors of the law was, in the beginning, to avert by a strong supervision at the frontier the import of suspected or abnormal butter. This again was contrary to Art. 3 section 3 of the law of 12th July, 1895, authorising the Government to prevent the import of victuals, the quality of which does not come up to the standard fixed for similar articles prepared in the country itself.

Consequently one cannot demand of imported butter more than of the national produce.

By the way of amendment the following article was then inserted into the law.

"It is prohibited to sell or to put in a shop or in other places for sale, abnormal butter, that is to say, butter the quality of which, while not for certain pointing towards gross adulteration, diverges from that of the greater part of pure butters.

"The chemical and physical solids denouncing such qualities shall be fixed by Royal Decree."

An outsider might now, perhaps, suppose, that a Cabinet and a Legislative Council which introduced such a law, know and understand what is meant by abnormal butter. The contrary, however, is shown from the discussion. As has alas too often been the case with laymen in Holland, the Belgian ministers and deputies have also committed the error of establishing a connection between the quality of butter and its chemical composition. They have started from the thesis that a butter showing an abnormal composition in its physical and chemical analysis must perforce be a butter of inferior quality. Ignorance and want of reliable professional information are consequently the causes that a clause has been put in the Belgian butter law, which will have a disastrous result, not only for many foreign, but still more for the Belgian producers. The discussions held clearly proved that they did not know that chemically abnormal butter may be of very good quality, and on the other hand impure butter may stand the most exact claims in a chemical respect.

One would have thought that a producer should be able to judge from the appearance of butter whether its chemical composition is normal or abnormal. Thus the Minister of Agriculture said, "The law puts down as compulsory what honest producers already often do. I have noticed more than once, that the farmers do not bring more than half of their produced butter on the market; they regard the other half as being of inferior quality through the influence of thunder or excessive heat. 'We will not,' they said, 'bring butter on the market that runs through the basket, and thus spoil our good reputation.'"

From this it seems, that the Minister supposes that a farmer should be able to judge from the appearance only the percentage of volatile fatty acids, just as well as the firmness. One of the deputies, Mr. Broqueville, confirmed this opinion of the Minister in somewhat different terms, and in the following discussion the Minister defended and maintained his standpoint by saying, "The farmers will willingly refrain from bringing butter products to the market that do them no credit by their composition. They prefer to use this butter themselves rather than damage their reputation by selling such products."

From this again it is clearly shown that the Minister did not understand that the farmer cannot judge from taste or smell how many volatile fatty acids a certain butter contains, but that hereto a chemical analysis is required.

Notwithstanding the protests of some better informed deputies, the idea of the Minister and the amendment of Mr. Maenhaut predominated, and the above-mentioned article was passed. Not only did they not understand that the article is based on a totally wrong and absurd basis, but they understood even less that thus enormous harm was done to many compatriots who earn their bread with butter-making.

Through many different experiments by Belgian chemists it has been pointed out, that in some parts of Belgium, during a certain time of the year, the butter shows pretty well the same symptoms as the Dutch butter of Friesland (Frisia) during autumn. That Belgian butter also renders at a chemical analysis the same returns as, according to the conception of the Belgian butter law, stamps the product as abnormal, and consequently makes any selling of the same impossible.

Therefore, it is not astonishing that competent persons have strongly objected against a law which makes it impossible for a national product to be put in the market under its proper name, while butter of inferior quality, and adulterations, may freely be offered as butter provided it conforms with certain chemical stipulations.

At the general meeting of the Belgian Association of Chemists, the resolution was unanimously carried, that they consider the defence of Art. 10 of the butter law in the council as unscientific, and that it is considered desirable to institute in Belgium a complete and scientifically conducted enquiry into the causes governing the observed varying composition of butter.

Because in Belgium itself people protest so strongly against the unfairness, not to say absurdity of the new Belgian butter law, it may be expected, that, before long, a modification of Art. 10 may be introduced, admitting as proof for pure butter, other proofs of genuineness than only chemical composition, and that in consequence thereof, for instance, butter may be recognised as pure, even in case it be chemically abnormal, as long as its purity can be proved by a churning proof under authorised supervision.

Dr. J. J. L. VAN RYN.